GROUP 37A

POWER STEERING

CONTENTS

GENERAL INFORMATION

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Electric power steering system has been adopted for all models in order to ensure an optimised steering feeling.

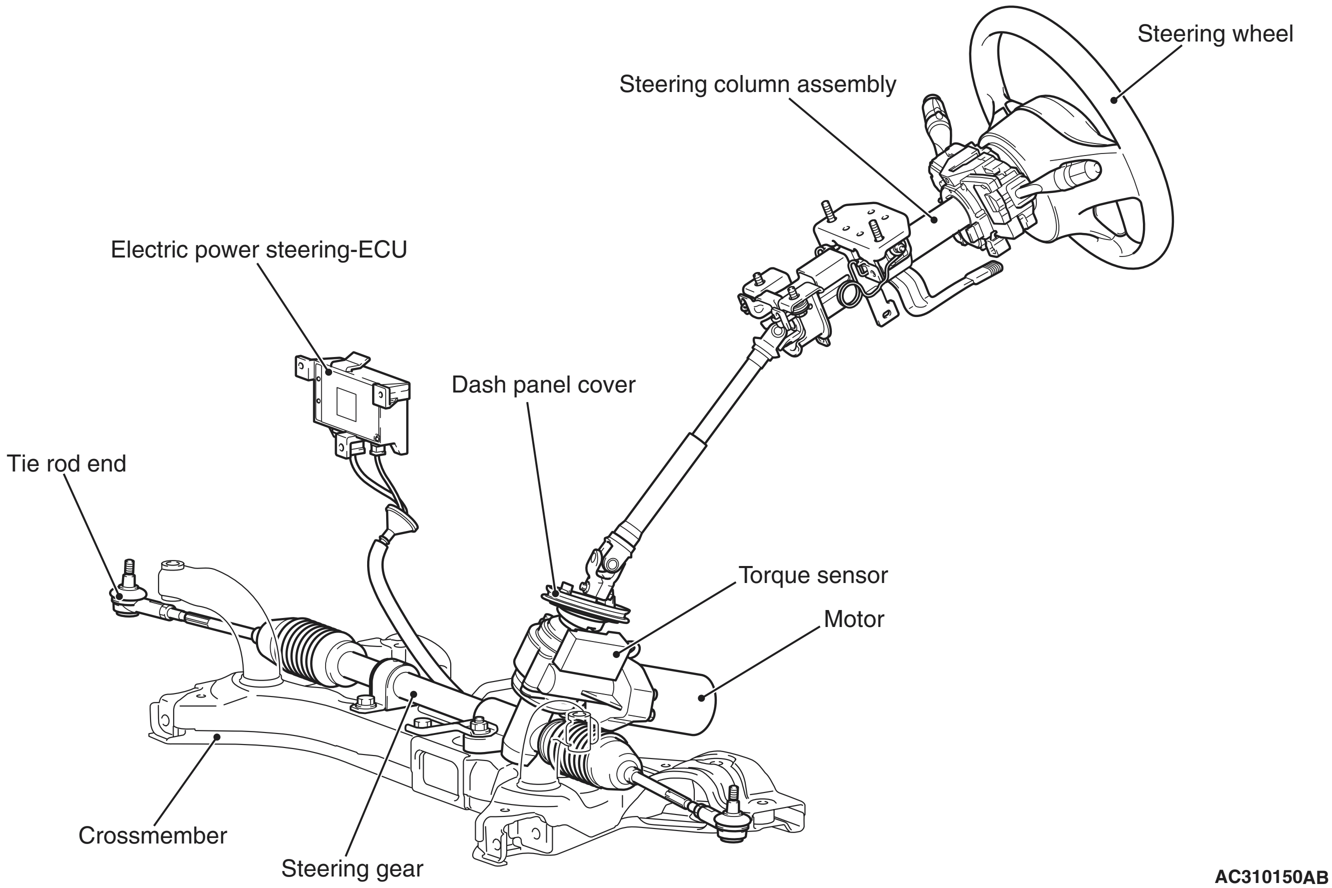
FEATURES

- Improved fuel consumption by reduction of engine load, and weight saving by decrease of the number of parts have been achieved with the introduction of the electric power steering system.
- 3-spoke type steering wheel integrated with an SRS airbag has been adopted.
- Impact-absorbing mechanism and tilt steering mechanism have been adopted.

SPECIFICATIONS

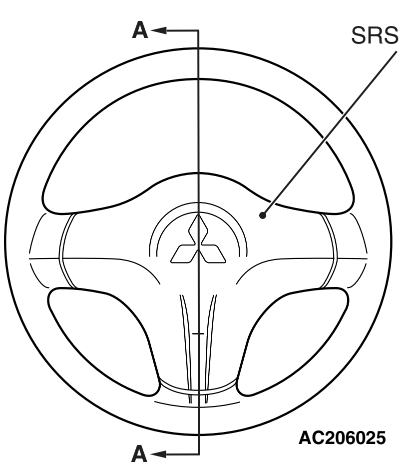
Item		Specifications
Steering wheel	Type	3-spoke type
	Outside diameter mm	370
	Maximum number of turns	3
Steering column	Column mechanism	Shock absorbing mechanism and tilt steering mechanism
Power steering type		Electrical controlled type
Steering gear	Type	Rack and pinion
	Stroke ratio (Rack stroke/Steering wheel maximum turning radius)	46
	Rack stroke mm	138
Steering angle	Inner wheel	36°40’
	Outer wheel	32°50’

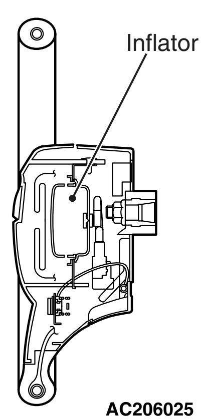
CONSTRUCTION DIAGRAM

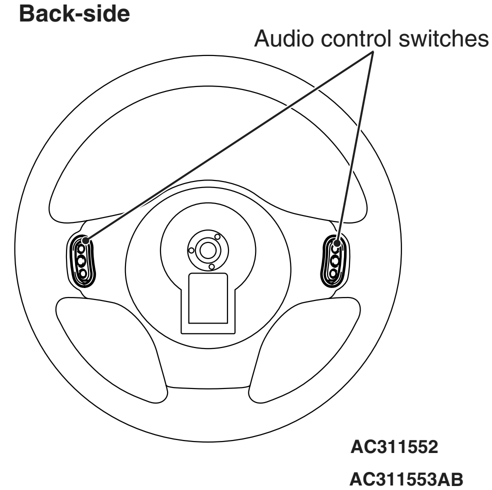


STEERING WHEEL

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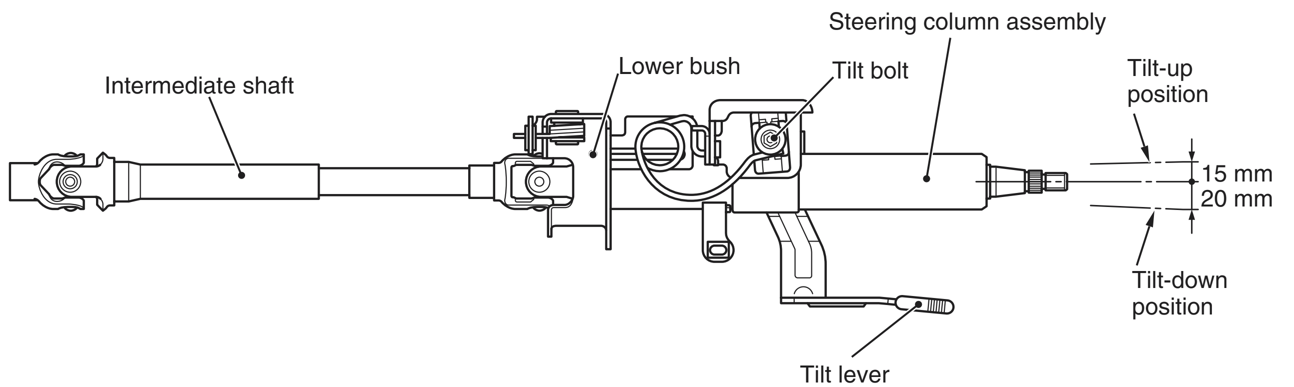
The steering wheel is designed to improve operability, safety and maintainability and has the following features:

- New 3-spoke type steering wheel which features urethane and genuine leather types has been adopted. The leather steering wheel is optionally available for all models.

- It incorporates an SRS airbag to protect the driver in the event of a frontal collision.
- The airbag module is equipped with an inflator that does not contain sodium azide.
- Audio control switches have been optionally adopted on the backside of the steering wheel for all models.

STEERING SHAFT AND COLUMN

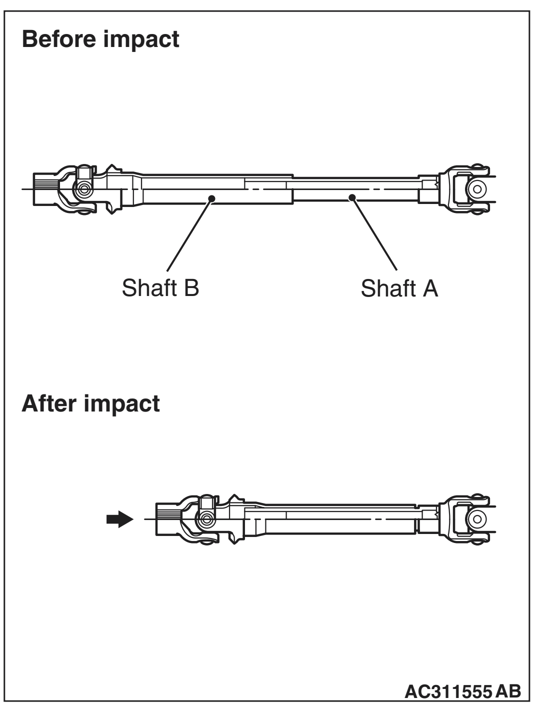
M2370002000247



Tilt steering mechanism allowing desired driving position (tilt-up/tilt-down: 15mm/20mm) has been installed for all models. Additionally, impact-absorbing mechanism has been introduced to the steering column to absorb an impact during collision and protect driver's safety.

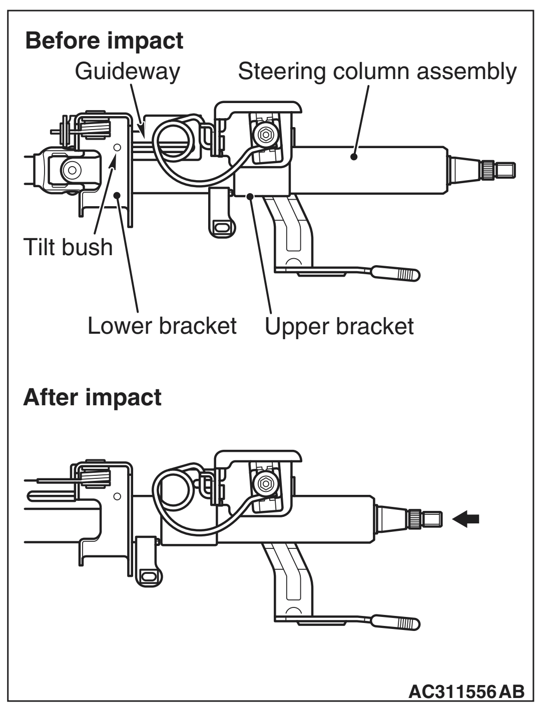
Impact-absorbing mechanism

PRIMARY COLLISION



When a vehicle is crashed and the lower shaft is loaded from the gearbox side, the shaft A is forced into the shaft B to absorb an impact load. Thus, the steering column will not be projected into the passenger compartment to reduce possible chest injuries.

SECONDARY COLLISION



When the load of the driver's body is applied to the steering wheel after airbag deployment, the steering column assembly moves forward and down along the tilt bush and guideway while sliding into the upper and lower brackets, absorbing an impact load.

ELECTRICAL POWER STEERING

GENERAL INFORMATION

M2370000100323

Vehicle-speed sensitive electric power steering (whole range type) has been adopted. This system allows a light steering force during stationary steering maneuvre or low speed driving, and a moderate steering force during medium or high speed driving. For vehicles with this system, the electric power steering-ECU controls the motor current according to the vehicle speed and steering force of the steering wheel. The electric power steering-ECU rotates the steering gear pinion by operating the steering gear motor to ensure appropriate steering force.

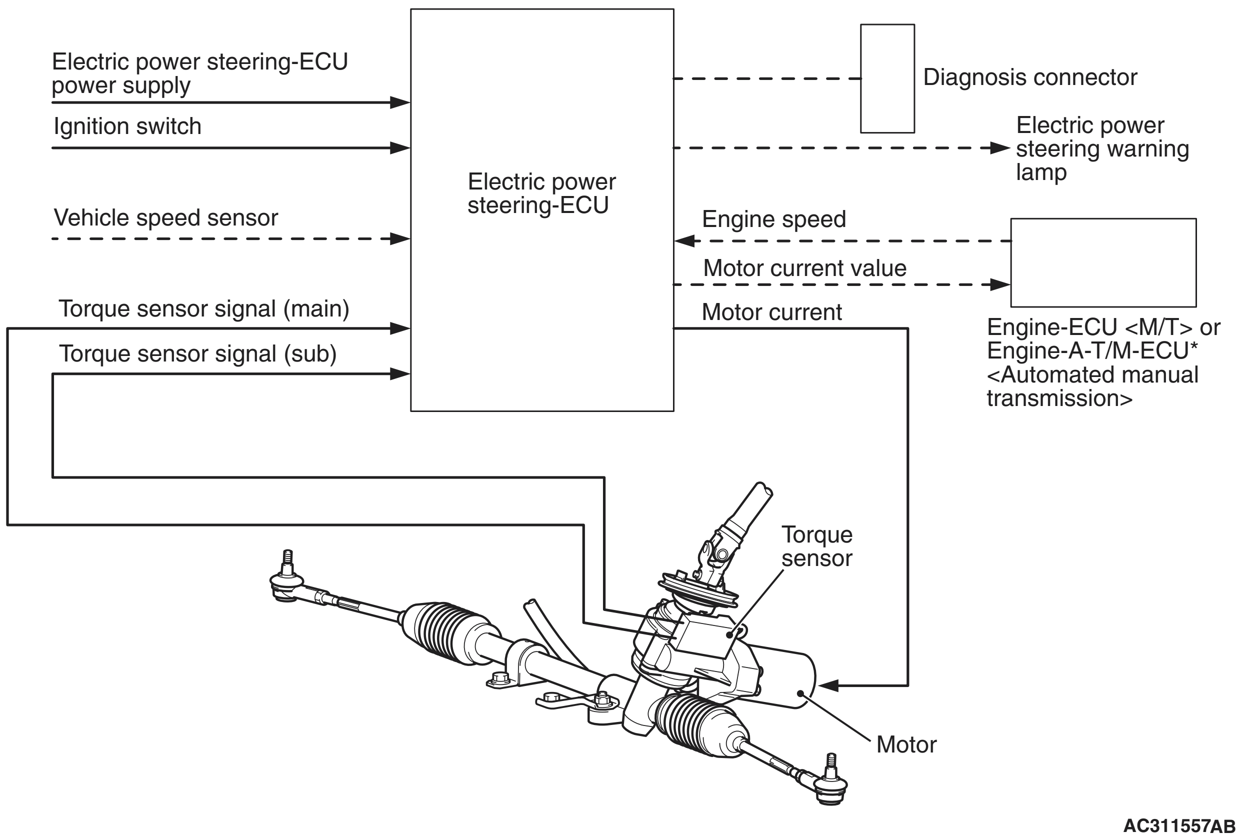
CAN* communication has been adopted in order to communicate with another ECUs for obtaining necessary information related to this control, achieving wiring harness saving and secure data communication.

*NOTE: **: For more information about CAN (Controller Area Network), refer to Group 54C.*

SPECIFICATIONS

Items		Specifications
Motor	Type	Permanent magnetic field type
	Rated voltage (V)	DC12
	Rated current (A)	50
Torque sensor	Type	Noncontact type (Inductance detection type)
electric power steering-ECU	Control type	Microcomputer control (16 bit)
	Rated voltage (V)	DC12

SYSTEM CONFIGURATION



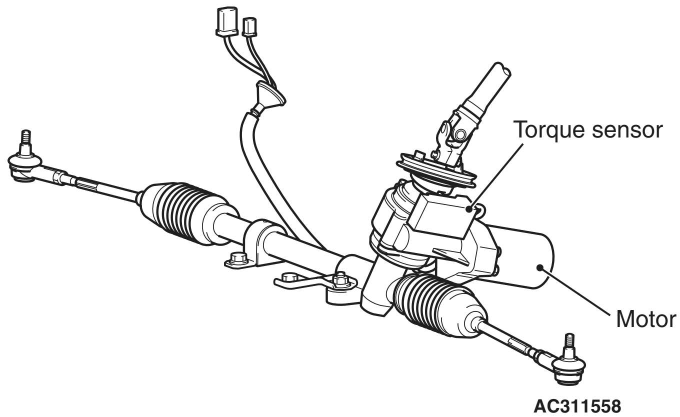
NOTE: Dashed lines indicate CAN-bus lines.

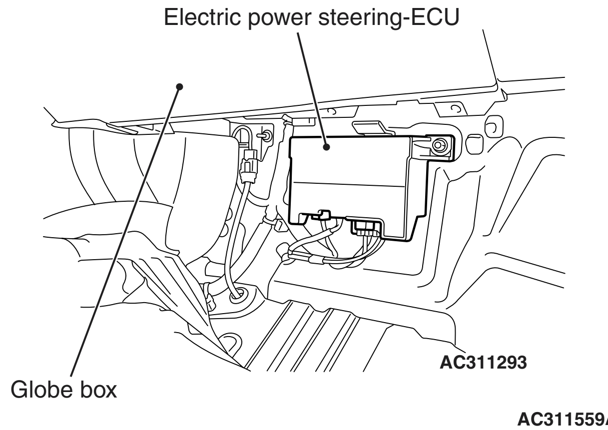
NOTE: Engine-A-M/T-ECU: Engine Automated Manual Transmission Electronic Control Unit*

ELECTRICAL PARTS AND FUNCTIONS

Parts Name		Description about functions
Sensor	Vehicle speed sensor (ABS-ECU)	Sends the vehicle speed signal to the electric power steering-ECU.
	Torque sensor	Detects a steering force, converts it into the voltage signal, and then sends that signal to the electric power steering-ECU.
Actuator	Motor	Transmits assist torque generatedy by the steering operation to the steering gear using the signals sent from the electric power steering-ECU.
	Electric power steering warning lamp	Warns a driver of the system malfunction using the signal sent from the electric power steering-ECU.
electric power steering-ECU		Controls the actuators (motors) based on the signals sent from sensors.
		Controls the self-diagnostic function and fail-safe function.
		Controls diagnostic function (Compatible with MUT-III).

GENERAL DESCRIPTION ON SYSTEM

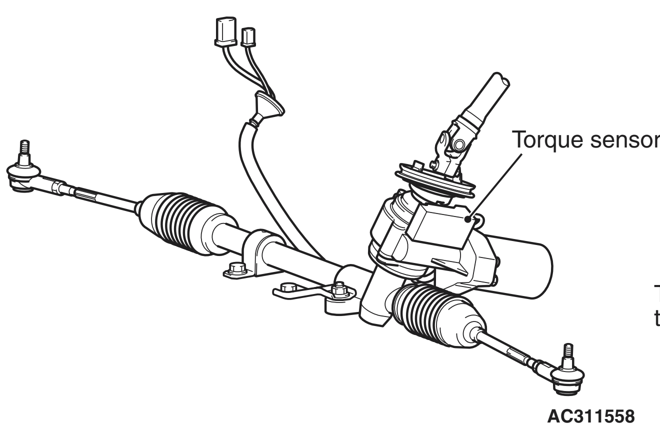


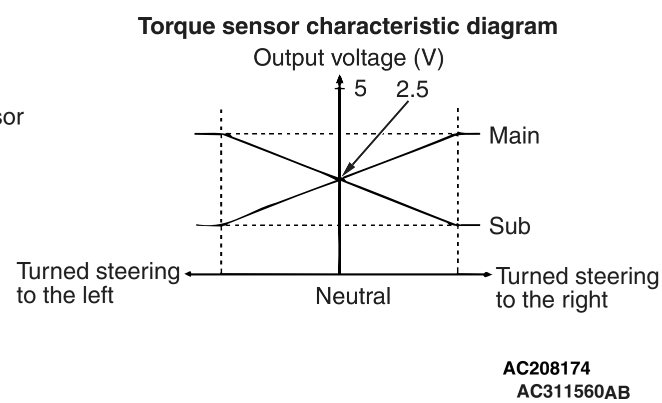


Electric power steering system detects a steering force by using a torque sensor which generates voltage based on the steering force of the steering wheel. It also detects vehicle speed and controls the motor current using the electric power steering-ECU, assuring an appropriate steering force. To improve operational reliability, the dual-circuit system has been adopted for the torque sensor. If any malfunction occurs in the electric power steering system, the fail-safe function of the electric power steering-ECU is activated, and the output current of the electric power steering-ECU applied to the motor is turned off. At the same time, the steering system enters manual mode, and informs a driver of the system malfunction by illuminating the warning lamp on the combination meter. The warning lamp illuminates when the following malfunctions occur: open circuit in the electric power steering system wiring harness, poor connection, malfunctions in the electric power steering-ECU, motor, or sensors.

STEERING GEAR

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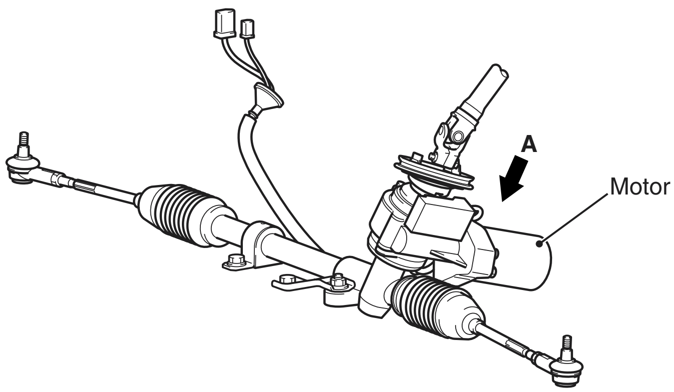


The steering gear, which transmits a control force of the steering wheel to the electric power steering-ECU, consists of the torque sensor and motor.

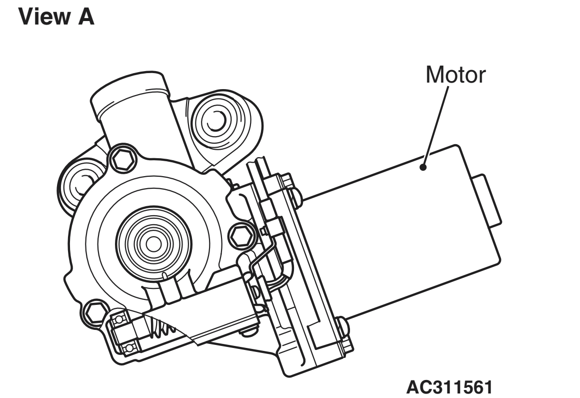
The torque sensor which detects a control force of the steering wheel is installed to the steering gear. When the steering wheel is turned, the steering force is transmitted to the torque sensor. At the same time, 2-way supply voltage signal (main and sub) generated in proportion to the steering force is input to the electric power steering-ECU.

MOTOR

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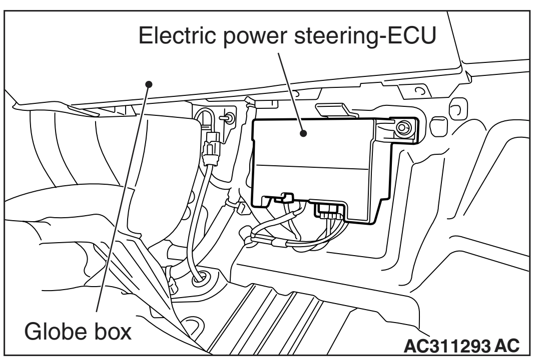


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The motor is installed to the steering gear. The steering motor is applied with a control current sent from the electric power steering-ECU and transmits the assist torque to the steering gear according to the steering operation.

ELECTRIC POWER STEERING-ECU

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The electric power steering-ECU is attached below the glove box, which is integrated with an input interface circuit, a microcomputer, a output drive circuit, a fail-safe relay, and a motor line relay.
It is also integrated with a self-diagnostic function, and illuminates the warning lamp and outputs DTCs to the diagnostic connector.

CAN COMMUNICATION

The electric power steering-ECU performs the data transfer with another ECUs through CAN communication.

Signal	**Receiver ECU**				
	Engine CVT-ECU	**ABS-ECU**	**Electric power steering-ECU**	**Meter A/C-ECU**	**ETACS-ECU**
Motor current signal	•	–	–	–	–
Electric power steering warning lamp request signal	–	–	–	•	–

FAIL - SAFE FUNCTION

If the electric power steering-ECU detects any malfunction, it illuminates the warning lamp, deactivates the electric power steering function, and then switches the steering system into manual mode.

DIAGNOSTIC FUNCTION

Electric power steering-ECU has the following functions for easier system checks.

- Diagnosis code set
- SERVICE DATA OUTPUT
- Actuator test

All the above items can be diagnosed using MUT-III.

DIAGNOSIS CODE SET

There are 22 diagnostic items. Since all the diagnostic results are recorded in volatile memory (EEPROM*), they are stored in the memory even though the battery terminals are disconnected.

NOTE:
- **EEPROM (Electrical Erasable & Programmable ROM): Special type of memory that can be programmed or erased electrically.*

Diagnosis code No.	Diagnostic item	Reference pages or actions
C1511	Abnormal torque sensor (main)	
C1512	Abnormal torque sensor (sub)	
C1513	Torque sensor signal voltage is excessively different between main system and sub system.	
C1514	Abnormal torque sensor power supply	
C1521	Abnormal vehicle speed sensor input	
C1522	Abnormal engine speed input	
C1531	Abnormal motor terminal voltage	
C1532	Excessively high motor current	
C1533	Overcurrent in motor	
C1534	Excessively low motor current	
C1541	Fail-safe relay is stuck to ON.	(Replace EPS-ECU).
C1542	Fail-safe relay is stuck to OFF.	
C1607	Abnormal ECU (microcomputer)	Replace EPS-ECU.
C1860	Abnormal power supply voltage (too high)	
C1861	Abnormal power supply voltage (too low)	
U1073	Bus off	
U1100	Engine-related CAN communication time-out	
U1102	ABS-ECU CAN communication time-out	
U1120	Engine-related CAN communication failure information	
U1122	ABS-ECU CAN communication failure information	
U1303	Data Length Error	Replace engine/CVT-ECU or EPS-ECU.
U1312	Data Length Error	Replace ABS-ECU or EPS-ECU.

SERVICE DATA OUTPUT

Using MUT-III, the input data sent from the sensors and motors can be read.

1. The system is normal

Item No.	Check items	Check conditions		Normal conditions
01	Torque sensor (main)	• Start the engine. • Turn the steering wheel with a vehicle stationary.	Centre position	Approximately 2500 mV
			Steering wheel turned to right	2500 – 4500 mV
			Steering wheel turned to left	500 – 2500 mV

Item No.	Check items	Check conditions		Normal conditions
02	Torque sensor (sub)	• Start the engine. • Turn the steering wheel with a vehicle stationary.	Centre position	Approximately 2500 mV
			Steering wheel turned to right	2500 – 500 mV
			Steering wheel turned to left	4500 – 2500 mV
03	Torque sensor supply voltage*	Start the engine.		3750 – 4250 mV
05	Motor current	• Start the engine. • Turn the steering wheel to the left and right with a vehicle stationary.		Approximately 50 A or less
06	Motor current (desired value)	• Start the engine. • Turn the steering wheel to the left and right with a vehicle stationary.		Approximately 50 A or less
07	Assist limit current (limit value)	• Start the engine. • Turn the steering wheel to the left and right with a vehicle stationary.		Approximately 50 A or less
10	Relay voltage	• Start the engine. • Turn the steering wheel to the left and right with a vehicle stationary.		B+ (approximately 12 V) or less
11	Vehicle speed	Perform a test run of the vehicle.		Speedometer displayed value and MUT-III displayed value agree with each other.
12	Engine speed	Start the engine.		Tachometer displayed value and MUT-III displayed value agree with each other.
14	Fail-safe relay	Stop the engine. (Ignition switch: ON)		OFF
		Start the engine, and let it idle.		ON
15	Ignition switch key signal	Ignition switch: from ON to OFF		OFF
		Ignition switch: ON		ON

NOTE: Item No.13 (idle-up relay) is displayed on MUT-III. In this case, however, the idle-up signal is not accepted by the engine-ECU, and the idle speed will not actually increase. Therefore, the item No.13 is excluded from the above table.

*NOTE: *: Torque sensor is supplied either with 3 V or 8 V. Only the 8 V side of the torque sensor power supply can be monitored by MUT-III as service data (Output is 8V x 0.5). Even though the 8 V side torque sensor power supply is normal, diagnosis code C1514 (abnormal torque sensor power supply) is displayed if any malfunction occurs in the 3 V side power supply.*

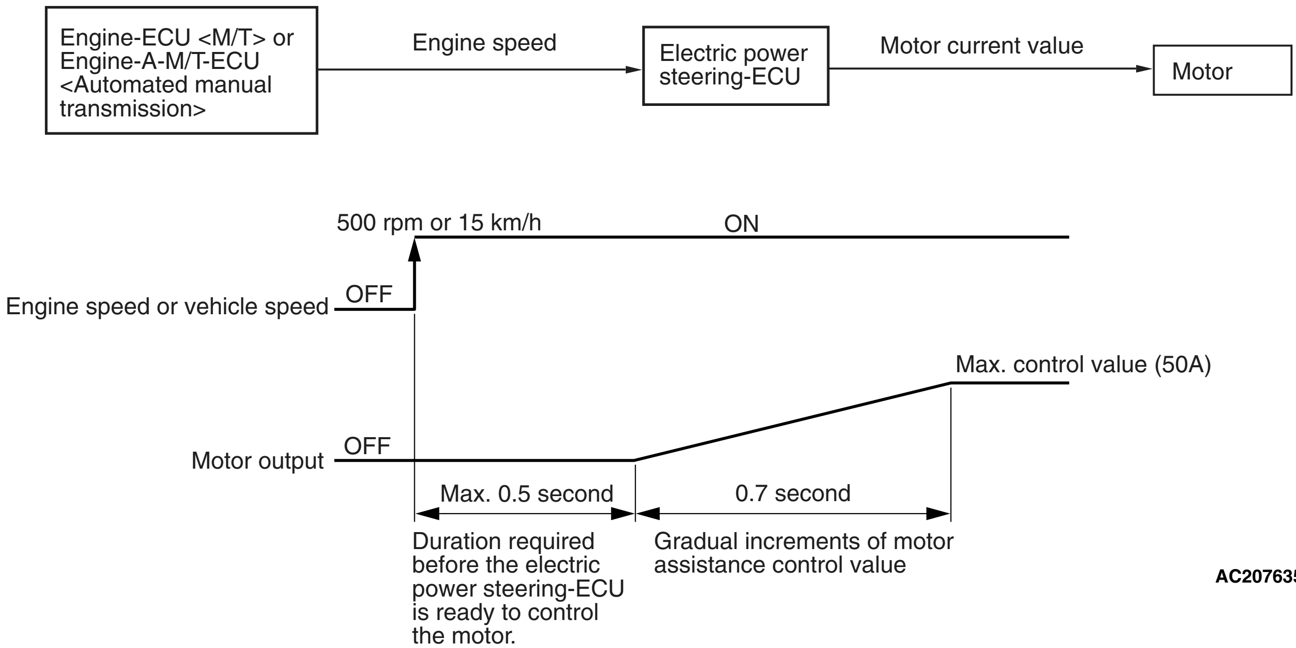
OPERATION

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IGNITION SWITCH ON

Ignition supply voltage is applied to the electric power steering-ECU, and the ECU enters standby mode.

IGNITION SWITCH ON

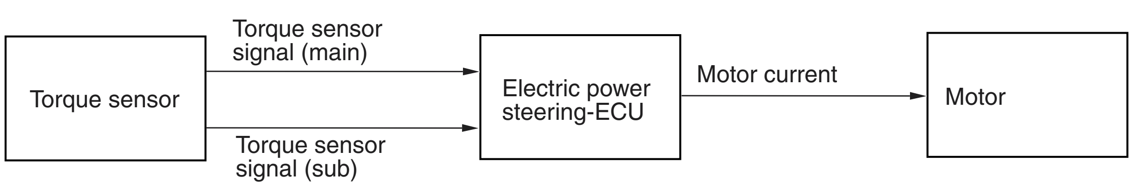


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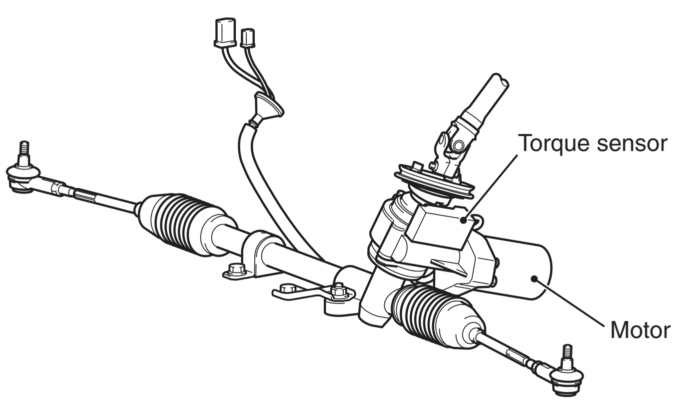
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1. When the engine is started, the engine speed signal sent from the engine-ECU is input to the electric power steering-ECU.
2. After starting the engine, the electric power steering-ECU identifies the engine status as "ENGINE SPEED ON" when the engine speed reaches 500 rpm or the vehicle speed reaches 15 km/h or more, enabling power assist function.

STEERING WHEEL OPERATION



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1. When the steering wheel is operated, the torque sensor integrated into the gear box detects the steering torque and outputs the torque sensor signal (main and sub), which varies with the steering force, to the electric power steering-ECU.
2. The electric power steering-ECU outputs the current in proportion to the torque sensor signal to the motor.
3. The motor outputs the rotational torque (assist torque) in proportion to the current intensity and assists the power steering gear.

FAIL-SAFE FUNCTION OPERATION

During the fail-safe mode, the electric power steering operates as a manual steering system.